GSM BASED WIRELESS CONTROL OF ELECTRICAL APPLIANCES

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May 2014

GSM BASED WIRELESS CONTROL OF ELECRICAL APPLIANCES

A dissertation submitted in partial fulfilment of

the requirements of

Bachelor of Technology in Electrical Engineering

by

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Declaration

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Rourkela, May 2014

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This is to certify that the thesis entitled **"GSM based wireless control of electrical appliances"** being submitted by Mr. V.UdayAditya (Roll No-110EE0186) and Ms. Pallavi Gangber (Roll no-110ee0195) submitted to the National Institute of Technology (Deemed University) for the award of degree of Bachelor of Technology in Electrical Engineering, is a bona fide research work carried out by them in the department of Electrical Engineering, under my supervision and guidance. We believe that this thesis fulfils a part of requirements for the award of degree of Bachelor of Technology. To the best of my knowledge and belief the research reports and results embodied in this thesis have not been submitted in parts or full to any other University or Institute for the award of any other degree or diploma.

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Acknowledgements

First and Foremost, We are truly indebted and wish to express my gratitude to my supervisor Professor Prasanna Kumar Sahu for his inspiration, excellent supervision, continuing encouragement and unwavering confidence and support during every stage of this project work, without which, it would not have been possible for me to complete this project successfully. We also thank him for his insightful comments and suggestions which continually inspired me to explore new dimensions of research.

We express my deep gratitude to the Head of Electrical Engineering, NIT Rourkela and all the faculty members of the department for providing all the facilities towards this project work.

Vasumsetty Uday Aditya,

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Rourkela, May 2014

ABSTRACT

It is basically known that any electrical appliance is controlled with a switch that regulates the electricity to electrical devices. As a reason of the latest technological advances, automation and wireless control of devices has becoming more popular. This project puts forth the equipment which enables users to control their home appliances using their cellular phone. It shows the construction and working of the device to wirelessly control the home appliances based on GSM networking and 8051 microcontroller. Initially an authenticated signal is sent from the user's cellular phone via Global System for Mobile Communication (GSM) network to the phone which is fixed to the equipment. This signal or code consists of the information about the function or action to be taken place i.e. what appliance should be turned off or turned on. The receiver phone receives the DTMF signal or a SMS message that is send from the user's phone and then sends it to the DTMF decoder or the GSM modem which in turn sends the output digital signal to the microcontroller. Then the microcontroller, based on the received signal, controls the different relays connected through ULN2003 (Darlington transistor) and triggers the required appliance.

Key words: GSM communication, Wireless Control, SMS, DTMF

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CHAPTER 1

INTRODUCTION

1. INTRODUCTION

During the present days technology is all about the automation and wireless control of all the equipment used in industries, factories and households. Any equipment that can be controlled wirelessly is more easily maintained and it responds very fast comparing to the manual operation of the equipment. It increases safety as well as speed of operation in times of failure or damage. So here we present a design which uses wireless technology for switching of electrical appliances. This project uses the application of wireless communication i,e. GSM network for the wireless control of the electrical appliances.

In this project the applications of GSM network for the design of a circuit to control the house hold appliances is shown, and also the design of the circuit and method to construct the system using GSM modem and 8051 microcontroller is explained. Various uses and limitations of the system are being briefed.

1.1 MOTIVATION

As a reason of drastic developments in the field of wireless communications these days, the applications of this technology can be used in various sectors for making daily tasks comfortable and easy.

One such application can be used for control of electrical appliances which results in effective and efficient use of electrical power reducing the loss. This area has yet to be explored in major parts of the world. So we would like to take this opportunity to put forward a cost effective method for the wireless switching of the electrical appliances.

1.2 OBJECTIVE

The main aim of the design provided in this project is to develop a device to have wireless control of home electrical appliances. The device can be made sure to be available at a low cost so that everyone can afford it. This is basically a device built for home appliances control system that can provide remote access to house hold electrical appliances at low cost and in efficient way. The electrical devices connected in the home, office or any place, consume electrical power, and there is an absolute necessity of saving of power as per present day situations. So it is necessary to control electrical devices more effectively and efficiently at anytime from anywhere. So this project is built for the sole purpose of efficient control of electrical appliances.

This project is basically built on the process of wireless communication through the GSM network. GSM plays a very important role in the present day life of a person. Each and every person now-a-days has a cell phone with him, and GSM network makes the people across the world to communicate with each other. So as technology is increasing so vastly now-a-days, everything in the world is being automated and wireless for the comfort of man. So here we are building a device based on the GSM network to control the electrical appliances through a cellular phone. Here we are going to design a cell phone based remote control of electrical appliances. This system is designed for controlling arbitrary devices according to the necessity. It includes a cell phone which is connected to the designed system. Basically for the system to work a phone call is made to the designated number or a message is being sent containing a password. As the caller press the specific password, it results in turning ON/OFF of the particular device. The switching of devices is achieved by relays.

CHAPTER 2

BACKGROUND

AND

LITERATURE REVIEW

2. BACKGROUND

Now-a-days there is a huge advancement in the communication sector. Almost all people now-a-days have access to mobile phones and thus the world has indeed become a global village. At any given moment, any person across the world can be contacted with the help of a mobile phone. But mobile phones can not only used for the calling and sending SMS purposes but also new ideas can be generated and techniques can be developed from it that can further enhance its capabilities. There are huge technological advancements in wireless communication like Infra-red and Bluetooth which mostly took place in the recent years shows that the further improvements are in fact possible to make our life more easy and comfortable. Having wireless control of almost all the things in a person's life is a growing interest and many systems are developed providing such controls. So based on this idea we have designed a control system which is based on the GSM technology that effectively allows control from a remote area to the desired location. Because of this system, there is no need for a person to physically present to switch on/off the electrical appliances.

Here our main objective is to design a system that will enable us to have a complete control of the interface on which it is based. General objectives of the project are:

- To co-ordinate appliances and other devices through the GSM network.
- To eliminate the need of being physically present in any location for tasks involving the operation of appliances within a household/office.
- Minimize power and time wastage.

2.1 GSM TECHNOLOGY

GSM implies worldwide framework for versatile correspondence. GSM is a global advanced cell telecommunication. The GSM standard was proposed by ETSI (European Telecommunications Standard Institute) in 1989. The primary business administrations were launched in 1991 and after its initial presentation in Europe, the standard went worldwide in 1992. From that point forward GSM has turned into the most broadly embraced and quickly developing advanced standard, and it is situated to turn into the world's overwhelming cell standard.

Today's third era GSM systems convey excellent and secure versatile voice and information administrations with full abilities over the world. GSM is a massively fruitful engineering and as uncommon story of worldwide accomplishment. Since the first GSM system was industrially launched, it turned into, the world's heading and fastest developing portable standard. The GSM Association evaluates that advances characterized in the GSM standard serve 80% of the worldwide portable business, including more than 5 billion individuals crosswise over more than 212 nations and domains, making GSM the most omnipresent of the numerous guidelines for cell systems.

Today's GSM stage is living, developing and advancing and as of now offers an extended and characteristic-rich "family" of voice and empowering administrations. The Global System for Mobile Communication (GSM) system is cell telecommunication system with an adaptable structural planning following the ETSI Gsm900/GSM 1800 standard. Seimen's usage is the advanced cell versatile correspondence framework D900/1800/1900 that uses the precise most recent innovation to meet each prerequisite of the standard.

2.2 DTMF (Dual Tone Multi Frequency)

The main principle of the DTMF is that it takes a number code from the number pad converts it to DTMF (Dual tone multi frequency) signal and a DTMF decoder converts the DTMF signal to a digital code that can be fed to a microcontroller. A DTMF generator generates two frequencies corresponding to a number or code in the number pad which is transmitted through the communication networks, constituting the transmitter section which is simply equivalent to a mobile set. In the receiver part, the DTMF detector IC, for example MT8870 detects the number code represented by DTMF back, through the inspection of the two transmitted frequencies. The DTMF frequencies representing the number codes is shown below.

Table 2.2.1 DTMF frequencies corresponding to different number codes

1	2	3	A	697 Hz
4	5	6	B	770 HZ
7	8	9	C	852 Hz
*	0	#	D	941 Hz
1209 Hz	1336 Hz	1477Hz	1633 Hz	

DTMF generation is a composition of two audio signals or two tones between the frequency 697Hz and 1633Hz. In a DTMF each row has its own unique tone frequency and also each column will have its own unique tone. The tone frequencies are selected such that harmonics and intermodulation products will not cause any unreliable signal. Each and every tone falls within a proper band pass before valid decoding takes place. If one tone falls outside the band pass spectrum, the decoder will become unreliable. A DTMF decoders main purpose is to detect the sinusoidal signals in the presence of noise.

2.3 GSM Module

GSM module SIM300 is being used in the project here. It is just like a cell phone with all the facilities of sending and receiving a message, sending and receiving calls. It has a communication that can be programmed using AT commands. The signal names for the GSM modem communication port include the following; audio input and output pins (for connecting external hands free audio devices), mute control pin, flash programming signal pins, external power pins, and receiver and transmitter pins.

Here the RX and TX pins are used for the serial communication with the microcontroller. There are various AT commands to check the signal strength and connection and SIM status etc. Here the Hyper Terminal is used to initially interface with the computer to check the module. It also has an antenna to receive the GSM signal from the user's phone. The basic AT commands are loaded into the program of microcontroller for it to interface with the GSM module. The figure given below shows a GSM module.

FIG 2.3.1 GSM Module SIM300

2.4 8051 Microcontroller

At whatever point we are learning about new machine we need to think about the machine capacity we are utilizing and we can do it by studying the internal hardware design (device building design), and additionally to think about the size, number and the extent of the registers.

A microcontroller is a single chip that contains the processor, the ROM, the RAM, a clock and an I/O control unit. It is additionally called a "workstation on a chip"(small computer). Now a days billions of microcontrollers units (Mcu's) are inserted every year in a different items from toys to spaceships. Case in point, a single vehicle utilizes 70 or more microcontrollers. The below figure portrays a general block diagram of microcontroller.

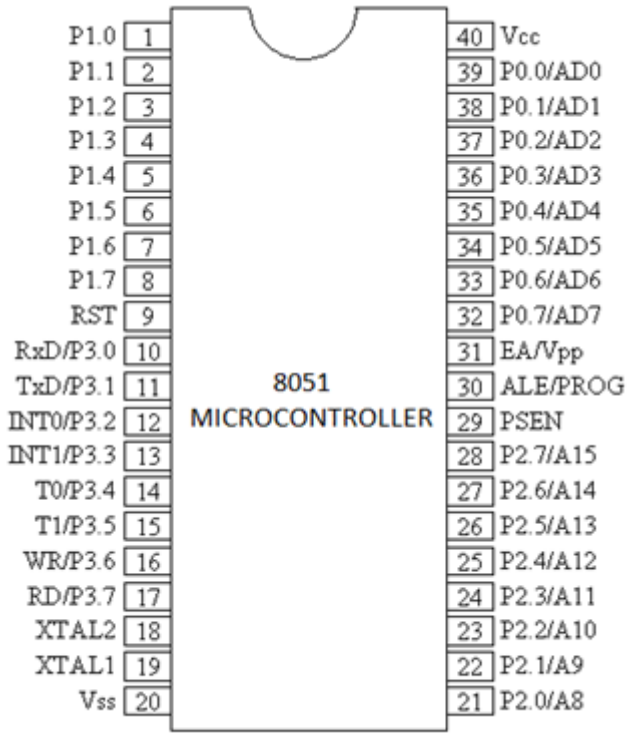

Fig 2.3.2 Block diagram of 8051 Microcontroller

The 8051 structure consists of the following specific characteristics:

- 16 bit PC & data pointer (DPTR)
- 8nbit program status word (PSW)
- 8 bit stack pointer (SP)
- Internal ROM of 4kb
- Internal RAM of 128 bytes
- 4 register banks each containing of 8 registers
- 80 bits of general purpose data memory
- 30 I/O pins arranged as 4 8 bit ports (P0-P3)
- Two 16 bit timer/counter (T0-T1)
- Two external and three internal interrupt sources Oscillator and clock circuits.

CHAPTER 3

METHODOLOGY

3. METHODOLOGY

3.1 CIRCUIT DESIGN AND PROCEDURE

The block diagram of our project is shown below in the fig3.1.0. It is an outline description of how we have implemented our project and the various steps involved in it. From the block diagram given below, the first mobile station is used as a transmitting section from which the user sends a code that contains commands and instructions to the second mobile station which is based on a specific area where our control system is located, through GSM network. The received code can be in either DTMF format which is send to the DTMF decoder connected via headset jack of the phone or through an SMS.

The DTMF decoder converts it into digital signal and sends it to the microcontroller interfaced to it. Then the microcontroller processes the code and carries out the specific operations. The ULN2003 is used to drive the relay circuits which switches the different appliances connected to the interface.

After connecting the circuit properly and assuming all the connections are right the following steps are to be followed:

- The remote user send authenticated signal including commands to the receiver phone.
- Through the GSM network the signal is received by the receiver phone on the device.
- Then that DTMF signal is passed to the DTMF decoder to convert it to the digital signal, and it sends them to microcontroller.
- Microcontroller issues commands to the appliances and the devices connected will switch ON/OFF.

And if we are using GSM module, that is SMS mode, the signal send in the form of SMS is send to the GSM module and then to microcontroller through serial communication and then microcontroller command the relays to switch the devices.

BLOCK DIAGRAM

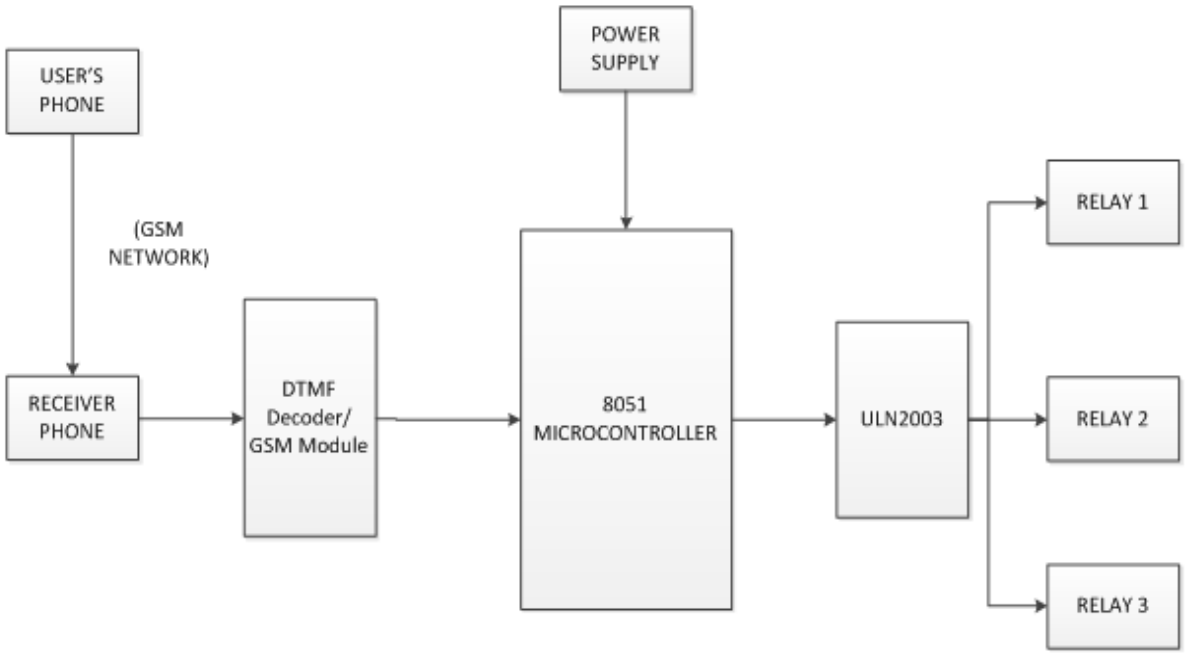

Fig 3.1.0 Block Diagram

3.1.1 EQUIPMENT REQUIRED

Table 3.1.1 Equipment Required

Sr.no.	Equipment	Device	Quantity
1	8051 microcontroller IC	AT89S52	1
2	DTMF decoder	MT8870	1
3	Crystal Oscillator	3.579545 MHz	1
4	Crystal Oscillator	11.0592 MHz	1
5	Relays	SPDT	3
6	Transistor (Switching)	ULN2003	1
7	LED's		4
8	Voltage Regulators	NJM7805	2
9	Transformer		1
10	Bridge Rectifier		1
11	Capacitors		As Req
12	Resistors		As Req
13	GSM module	SIM300	1

In addition to these a cellular phone is required which has to be connected to the device to receive the code from the user's phone. The resistors and capacitors are to be selected according to the ratings of these equipment selected and also for the efficient performance of the device.

The software required for the programming of the 8051 microcontroller is Keil µ Vision, in which we program the microcontroller to do the required work as desired, and finally all the basic things like the breadboard, input pins, sockets, soldering gun etc.

3.1.2 **POWER SUPPLY**:

Basically any electronic circuit runs with a power supply. Here we are giving a 5v supply to the various IC's used in the design presented here. We get a 240V supply in our house at any instant. So in order to provide our circuit appropriate supply voltage a different power circuit is to be made based on our requirement. The various steps included in the circuit are explained below stepwise. And also various precautions are to be taken for the safety of the electronic circuit designed. The different stages of the design of the circuit is given below.

1. TRANSFORMER:

We need a step down transformer of 220/12v output to supply all the electronics involved. Here in this device all the equipment require a DC input of 5v and since the regular input to the houses is 220v we need a transformer to step down voltages.

2. BRIDGE RECTIFIER:

The equipment needs a DC supply, so the output from the transformer is connected to a bridge rectifier to make it DC. A bridge rectifier basically has four diodes connected as shown below to provide rectification. This configuration is a widely used, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

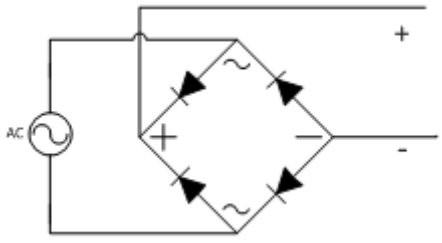

Fig 3.1.1 Bridge Rectifier

3. FILTER CIRCUIT

The filter circuit is simply a capacitor of 1000uf associated in parallel to the power circuit. It goes about as a filter that seems to be, it filters outs the ripples present in the circuit brought on throughout the rectification from the diodes in the bridge circuit. Regardless of the amount consideration is taken there are still ripples in the output voltage of the circuit, which is destructive for the IC's utilized. So filter capacitor evokes them, along these lines helping keeping up security in the outlined circuit.

4. VOLTAGE REGULATOR:

Then at last voltage controllers are associated over the circuit to secure the supplies from any kind of voltage variances. All the gadgets we utilize are delicate and sensitive, so protection from any kind of variances is very important. A voltage controller is intended to naturally keep up a consistent voltage level.

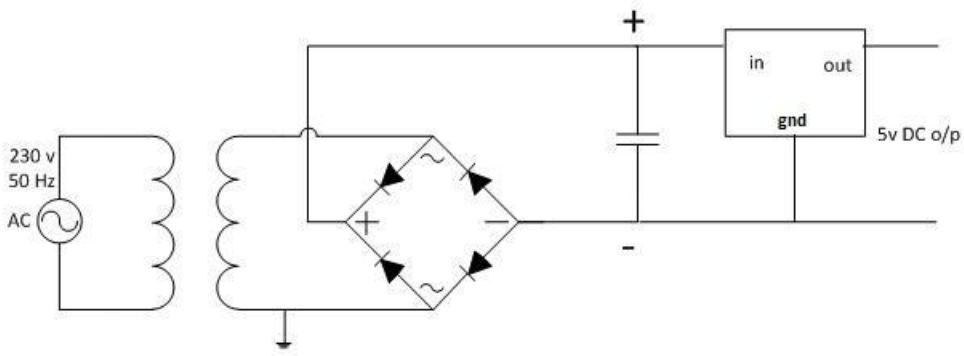

Fig 3.1.2 Power Supply Circuit

3.1.3 CONTROL CIRCUIT FOR BOTH DTMF AND SMS BASED DESIGN

The control circuit basically contains all the electronic parts and IC's, and its design is as follows:

1. DTMF DECODER:

Today, most telephone equipment use a DTMF receiver IC. One common DTMF receiver IC is the MT8870 that is widely used in electronic communications circuits. The MT8870 is an 18-pin IC. The pins are all connected as per the diagram shown below. The input is given at the pin in+/- and the digital output is taken the from the pins Q1, Q2, Q3, Q4.

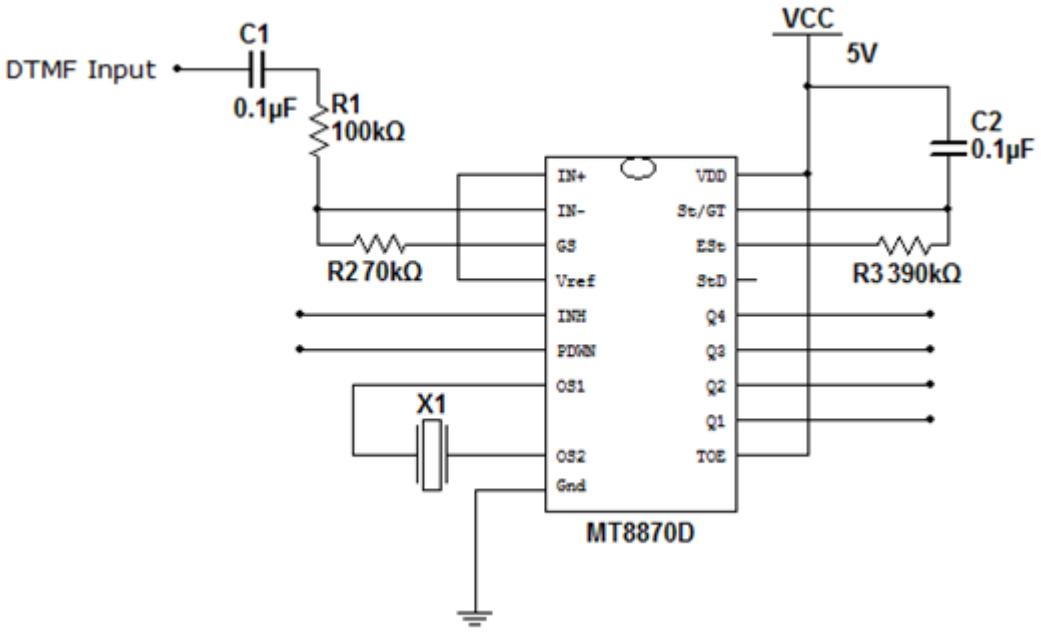

Fig 3.1.3 DTMF Decoder IC (MT8870)

2. 8051 MICROCONTROLLER (AT89S52):

The Atmel AT89S52 is a low power, high performance CMOs 8-bit microcontroller having 8K bytes of in-system programmable flash memory. The on flash memory permits the program memory to be further reprogrammed in-system or by a conventional non-volatile memory programmer. By adding versatile 8-bit CPU with in-system programmable flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller, which gives an exceedingly flexible and cost effective solution for a lot of people, embedded control applications.

The hardware part is driven by a set of program instructions, or software. User once familiar with hardware and software can easily apply the microcontroller to the problems. We program the microcontroller to take the digital output from the DTMF decoder through the pins of port P1, and then process to give the appropriate output through the pin of port P0 to the relays connected to switch ON/OFF of the particular appliances.

3. ULN2003:

ULN2003 is a high voltage and high current Darlington array IC. It contains seven open collector Darlington pairs with common emitters. It is an arrangement of a pair of bipolar transistors. Each channel or pair in ULN2003 is rated at 500mA and can withstand a peak current of 600mA. The inputs and outputs are provided opposite to each other in pin layout. Each driver additionally holds a suppression diode to dissipate voltage spikes while driving inductive loads. The logical output for it is a negation, i.e. it gives a low o/p for a high i/p and a high o/p for a low i/p. The logical diagram for the IC is shown below.

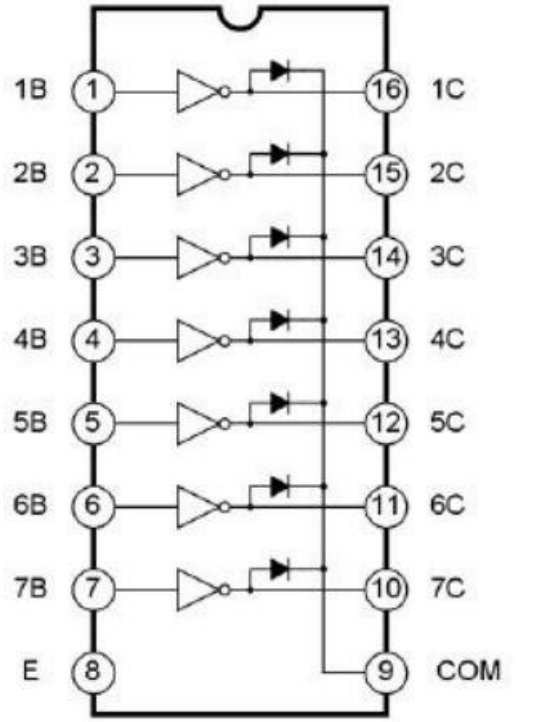

Fig 3.1.4 ULN2003 IC Logic Diagram.

4. RELAYS:

The relays are the final stage of this device which play a very prominent role to control the final appliances. The principle on that the relays work is electromagnetic force. When electricity starts flowing through a coil, it becomes an electromagnet. Steel plates are attracted by this electromagnetic coils get attracted, which is attached to a switch. So the switch's motion (ON or OFF) is controlled by current flowing through the coil, or not respectively.

A relay's very useful feature is that it can be used to isolate different parts of a circuit electrically. It allows a low voltage circuit (e.g. 5v DC) to switch the power in a high voltage circuit (e.g. 100v AC or more).

3.2 LIMITATIONS

- The proposed system only works in the places of good reception of signal and remote areas where there is no strong GSM signal, the equipment does not respond always
- There should be always continuous power supplied to the equipment so that the microcontroller and phone connected to it works.

CIRCUIT DIAGRAM

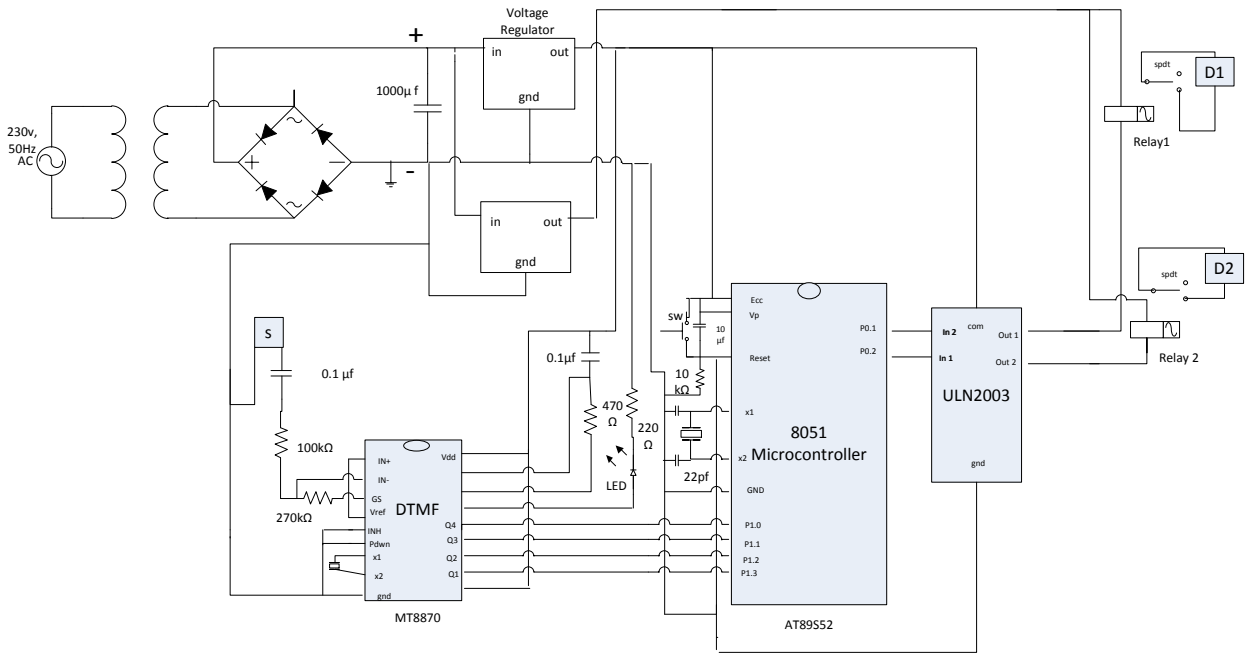

Fig.3.1.5 Circuit Diagram

CHAPTER 4

RESULTS

4. RESULT

4.1 SIMULATION RESULT

Proteus software has been used for the simulation of the circuit discussed above. As the DTMF decoder MT8870 is not present in the IC's given in the simulation, 8051 microcontroller is programmed to use as the DTMF decoder in this case. The simulation circuit is shown in the below given fig.5.1.1.

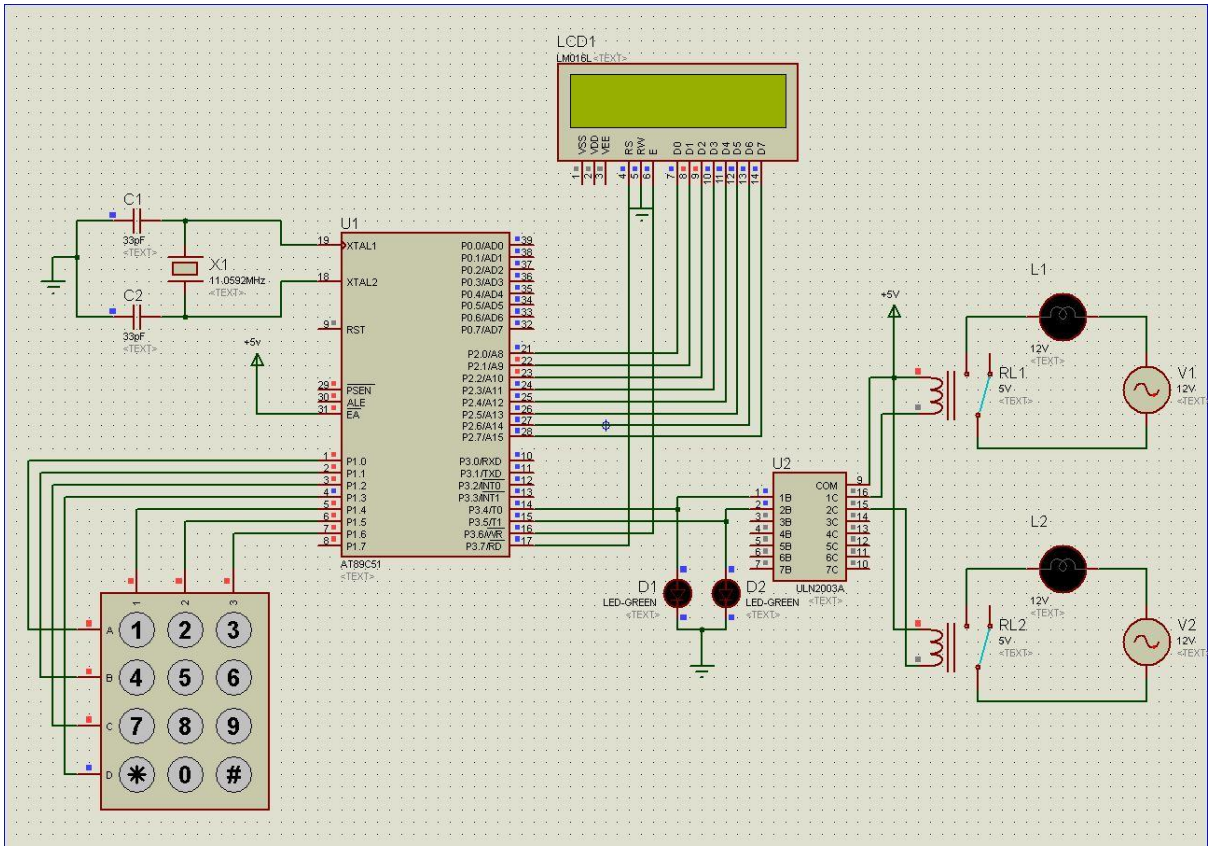

Fig.5.1.1 Simulation Circuit

The simulation circuit is build such that, the 8051 microcontroller receives the signal from the keypad through port P1 and it decodes the signal and then as per the authenticated code, it sends the signal to the relay connected to the pins P3.4, P3.5, and at the same time, the LCD display is being used for the display of the code given by the user, and it is connected to the microcontroller through the port P2.

The authenticated code given in this project is 78 and after that to select which device to be turned on, user select 1 or 2 and 0, 1 are pressed for on and off of the devices individually. The simulated output is shown in fig.5.1.2 and the program code for the microcontroller is given below.

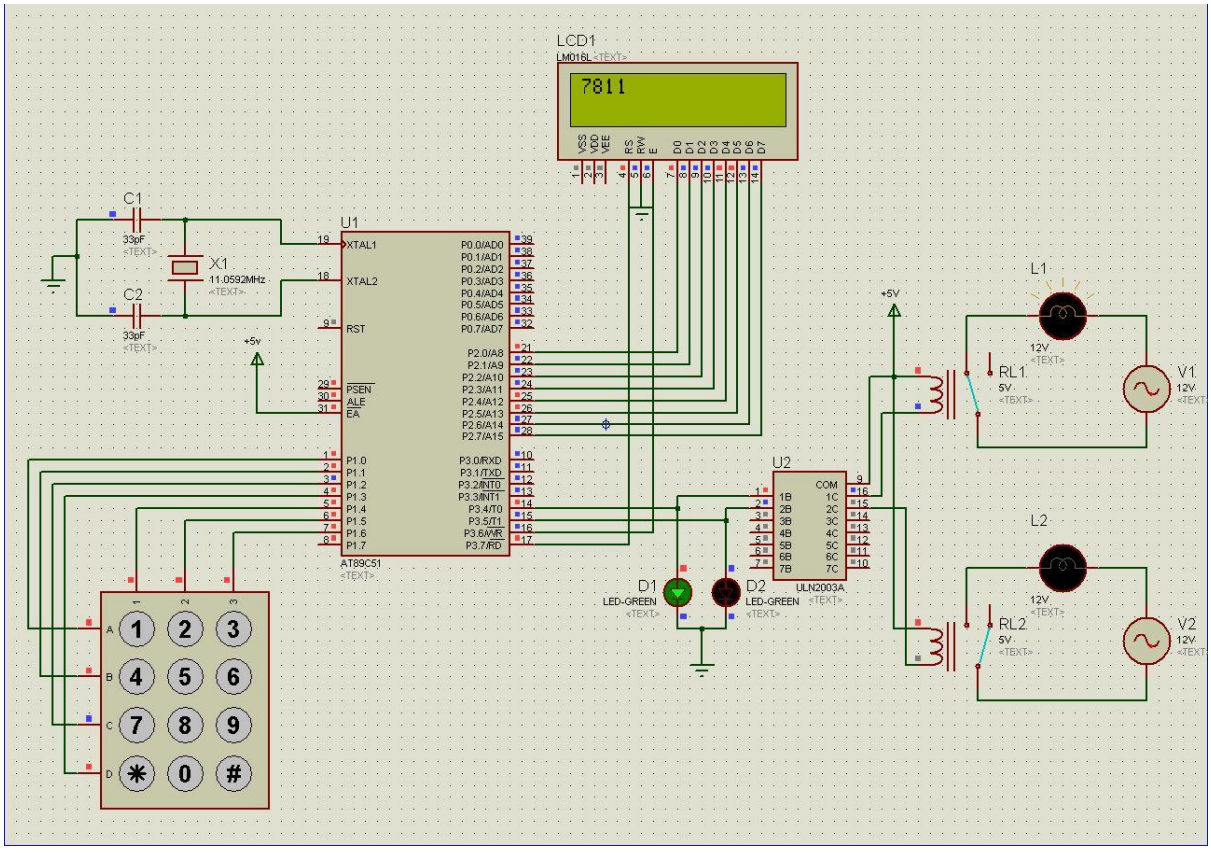

Fig.5.1.2 Simulation Result

CHAPTER 5

CONCLUSION

5. Conclusion

Conclusion:

The project is aimed to design and implement a GSM based wireless control of house hold electrical appliances.. After doing different tests and programming different codes, eventually the obliged outcome is put forward. It is a fast and efficient approach to control the devices. This equipment works anywhere with a great gathering od sign. At last the obliged result is attained with GSM module Sim300 based outline for effective and compelling result.

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